Effect of peppermint (*Mentha piperita*) supplementation on carcass yield, meat taste, heart weight, liver weight and some blood parameters in laying quail (*Coturnix Coturnix Japonica*) (2)

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**ABSTRACT**

This study was carried out to determine the effects of peppermint (*Mentha Piperita*) on blood parameters (cholesterol, triglyceride (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), malondialdehyde (MDA), antioxidant activity (AOA), total protein, glucose, carcass yield, heart, liver weights and organoleptic control of the carcasses in laying quails. A total of 180 15 week old laying quails were used in the study. There were 5 experimental groups which were supplemented with different ratios of Peppermint up to 5%. The control group received no peppermint supplements. The experiment continued for 10 weeks. Antioxidant activity and HDL amounts increased (P<0.05) in parallel with the increase of peppermint supplementation, while LDL, glucose, MDA amounts decreased (P<0.05) with the increase of supplemented peppermint. No effects were observed (P>0.05) on the carcass quality with a 5 % peppermint supplementation to the diet. In conclusion, the supplementation of peppermint to diets up to a 5% level was found to be quite beneficial in terms of blood parameters such as MDA, AOA, LDL, and HDL.

**Key Words:** Blood, Carcass, Heart and liver weight, Peppermint, Quail.

**INTRODUCTION**

Food and feed industry is gradually shifting to minimize the use of antibiotics and use of alternative natural products is increasing because antibiotics are resulting in drug resistance. In compliance with the complete ban on the use of antibiotics in poultry feed, manufacturers are interested to search and include alternative products for the human health safety. In this regard, there are many kinds of Phytogenic products which may serve as potential products, alternative to antibiotics since their essential oils possess antimicrobial activity (Nychas, 1995). These food additives can have possibility to be used as to prevent food spoilage or to inhibit the growth of food borne pathogens. It is well known that herbs are being used for medicinal purposes since prehistoric times (Dragland *et al*., 2003). Herbs and their products have some bioactive components ([alkaloids, bioflavonoid, bitters, flavonoid, glycosides, tannins, mucilage, saponins, (Vandergrift, 1998), guinones, phenols, phenolic acids, coumarins, essential oils, terpenoids, polypeptides and lectins) (Cowan, 1999)]. The amount of these compounds in each plant and their interaction has an important role on the action mechanism of the plant. However, the effects of these compounds and the polysaccharides on the metabolism are still not fully known (Guo *et al*., 2003).

The cellular membrane is a barrier, which prevents the mixing of cellular fluids with extracellular and also keeps the cell intact and functioning. Phospholipids and sterols are the major constituent component of cell membranes. Sterols serve to maintain the strength and permeability of cell membrane (Katarzyna *et al*., 2007). Cholesterol and Phytosterol analogues have potential to inhibit the absorption of intestinal cholesterol (Takeshita *et al*., 2007).

Cholesterol moves in the blood in the form of distinct particles which contains proteins and lipids as lipoproteins. Mainly three types of lipoproteins are found in the serum of fasting individuals which are HDL, LDL, VLDL and HDL-cholesterol, and their concentration level in the serum is inversely related with the risk for cardiac diseases (Circulation, 2002). It is evident that HDL lipoprotein provides effective protection against atherosclerosis development, while a low concentration of HDL in serum indicates the presence of some other atherogenic factors. By some recent clinical trials it has been proved that LDL is strongly valid and it shows that lowering therapy of LDL level in serum is very effective in reducing the risk of cardiac diseases (Circulation, 2002).

Atherogenesis is one of the more serious pathological conditions resulting from high levels of cholesterol and
also a highly significant risk factor for cardio vascular disease (Rozner et al., 2007). Most cardiologists are familiar with cholesterol and its “Jekyll and Hyde” characteristics of being both an essential constituent of cell membranes and a prerequisite for the development of atherosclerosis (Thompson, 1999).

Phytochemicals from fruits and vegetables have been shown to exert varied beneficial biological actions. For instance, flavonoids, the most common polyphenols found in plants, have been associated with the protective effects of various vegetables and fruits on the cardiovascular system (Runnie et al., 2004; Umezua et al., 2001). Their biological effects include antibacterial, antiviral, anti-inflammatory; antioxidant, free radical scavenging, and vasodilator effects and several natural antioxidants, while edible plant extracts promote endothelium-dependent vascular relaxation (Moreira et al., 2005; Carmen et al., 2000; Runnie et al., 2004). Peppermint (Mentha piperita) is commonly used in the treatment of loss of appetite, common cold, bronchitis, sinusitis, fever, nausea, vomiting and indigestion as an herbal agent. Peppermint is very well known as one of the leading medicinal herbs and is used by humans in many different forms for health purposes. Peppermint has been used for its antibacterial (Moreira et al., 2005; Gulluce et al., 2007), acaricidal (Kim et al., 2004), anti-inflammatory (Atta, 1998; Yamamura et al., 1998; Gherman et al., 2000; Asao et al., 2001), antioxidant (Gulluce et al., 2007; Marinova and Yanishlieva, 1997; Runnie et al., 2004; Capecka and Mareczek, 2005; Chanwitheesuk et al., 2005), insecticide (Franzios et al., 1997; Ansaria et al., 2000; Rajaa et al., 2001), antispasmodic (Gherman et al., 2000; Grigoleit and Grigoleit, 2005a), vasodilatory (Runnie et al., 2004), manipulator effect of rumen fermentation (Ando et al., 2003), ambulation-promoting effect (Umezua et al., 2001), antivirutic (Cowan, 1999; Schuhmacher et al., 2003), exceptionnal odor intensity (Gaudin, 2000), properties for centuries. The principal pharmacodynamic effect of peppermint oil relevant to the gastrointestinal tract is a dose-related antispasmodic effect on the smooth musculature wall of the gastrointestinal tract due to the interference of menthol with the movement of calcium across the cell membrane. The choleretic and antifoaming effects of peppermint oil may play an additional role in its medicinal use. Peppermint oil comprises 30-55% Menthol, 14-32% Menthone, 1.5-10% Isomenthone, 2.8-10% Menthy lactate, 1-9% Menthofuran and 3.5-14% Cineol (Grigoleit and Grigoleit, 2005a). Along with the beneficial effects of peppermint, in a previous study Cetingul et al. (2008) claimed that peppermint dried leaves supplementation might have adverse effects on egg yolk index and can cause embryonic death. Therefore, the use of natural dried peppermint in quail diet needs to be explored for its potential effect. In order to make use of the naturally existing chemicals in the structure of a plant, it is preferable to use plants in their natural forms rather than processed forms. This experiment was carried out to determine the positive or negative effects of ground peppermint plants used as a feed additive in quail nutrition.

**MATERIALS AND METHODS**

This study was reviewed and approved by the Animal Ethics Committee of the Afyon Kocatepe University, Turkey. This study is a part of our previous study (Cetingul et al., 2008).

**Experimental design:** 15 weeks old 180 quails (Coturnix coturnix japonica) were used in this experiment. The birds were divided into 6 groups (30 animals in each group). Each group was further divided into 6 subgroups containing 4 females and 1 male each. The 5 groups named: 1, 2, 3, 4, 5, were fed with rations supplemented by 1%, 2%, 3%, 4% and 5% of ground peppermint, respectively. The 6th group was used as a control group without any supplementation of peppermint. The experiment lasted for 70 days. The rations were formulated (Table 1) with isonitrogenic and isocaloric according to the NRC (1994), recommendations.

**Blood and carcass parameters:** From each subgroup one male bird was taken randomly at the end of the experiment and blood samples were taken after slaughtering. Serum HDL levels were determined by using Crescent Diagnostics Cholesterol test kit after precipitation of apo-lipoprotein B containing lipoproteins by phosphotungstic acid and magnesium chloride. Serum TP, glucose, TG and cholesterol values were measured with commercially available assay kits (Chema Diagnostika, Italy) by enzymatic methods. MDA was estimated according to a method developed by Draper and Hardley in 1990, based on the coupling of MDA with thiobarbituric acid. Plasma AOA was measured according to a relevant method (Koracevic et al., 2001), Carcass yield, weight of testicles, livers and hearts were determined. Palatability of meat was checked at the end of the experiment by grilling 6 carcasses from each of the 6 subgroups for 10 minutes; sampling and evaluating the taste in a range of 5 to 10 points by a committee consisting of 10 individuals.

**Statistical analysis:** The data obtained were statistically analyzed using SPSS Program (1998), designed for Windows. Statistical evaluation of data was carried out by one-way ANOVA for significant models (P<0.05). Mean values were examined statistically and significance of difference was tested with Duncan test.

**RESULTS AND DISCUSSION**

The results of our study were similar to the findings of another research (Hernandez et al., 2004), in that no significant difference was observed among the groups in terms of meat tests, carcass, liver, testicle, heart weights. Although the increase in liver weights of groups 4 and 5 was dramatic (Table 2), it was determined to have no statistical significance. The increased liver weights could be due to the dilatation of liver veins as previously reported (Akdogan
Table 1: Composition of the ration used in the experiment, %

<table>
<thead>
<tr>
<th>Feedstuffs</th>
<th>Control</th>
<th>Peppermint %1</th>
<th>Peppermint %2</th>
<th>Peppermint %3</th>
<th>Peppermint %4</th>
<th>Peppermint %5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>34.70</td>
<td>37.00</td>
<td>34.00</td>
<td>36.00</td>
<td>35.00</td>
<td>34.00</td>
</tr>
<tr>
<td>Wheat</td>
<td>30.00</td>
<td>27.00</td>
<td>28.00</td>
<td>27.00</td>
<td>27.00</td>
<td>26.00</td>
</tr>
<tr>
<td>Full fat soya</td>
<td>9.40</td>
<td>10.00</td>
<td>14.00</td>
<td>10.50</td>
<td>13.00</td>
<td>17.00</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>17.50</td>
<td>16.00</td>
<td>15.00</td>
<td>14.00</td>
<td>11.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Peppermint</td>
<td>-</td>
<td>1.00</td>
<td>2.00</td>
<td>3.00</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Fish meal</td>
<td>1.30</td>
<td>2.03</td>
<td>2.00</td>
<td>2.77</td>
<td>3.46</td>
<td>3.31</td>
</tr>
<tr>
<td>limestone</td>
<td>5.39</td>
<td>5.44</td>
<td>5.41</td>
<td>5.29</td>
<td>5.19</td>
<td>5.29</td>
</tr>
<tr>
<td>Dicalcium Phosphate</td>
<td>1.07</td>
<td>0.90</td>
<td>0.94</td>
<td>0.80</td>
<td>0.7</td>
<td>0.75</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin premix*</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>Mineral premix*</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>DL-Methionine</td>
<td>0.13</td>
<td>0.12</td>
<td>0.13</td>
<td>0.13</td>
<td>0.14</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Calculated Composition

- Metabolisable energy (MJ/kg) 12.13 12.11 12.12 12.02 12.04 12.05
- Dry matter (%) 89.10 89.20 89.20 89.10 89.10 89.20
- Crude fibre (%) 2.60 2.60 2.60 2.50 2.50 2.60
- Crude fat (%) 3.33 3.46 4.10 3.54 3.97 4.61
- Calcium (%) 2.47 2.50 2.50 2.47 2.47 2.49
- Available phosphorus (%) 0.35 0.34 0.35 0.35 0.35 0.35
- Methionine + Cystine (%) 0.71 0.70 0.71 0.71 0.71 0.70
- Lysine (%) 1.19 1.17 1.17 1.15 1.15 1.13
- Linoleic acid (%) 1.60 1.70 2.00 1.70 1.90 2.20

* Guaranteed levels of vitamin per 2.5 kg and mineral supplements per 1 kg product: vit. A: 12 000.000 UI; vit. D₃: 2 000.000 UI; vit. E: 35.000 mg; vit. K₃: 4000 mg; vit. B₁: 3000 mg; vit. B₂: 7.000 mg; vit. B₆: 5.000 mg; vit. B₁₂: 15 mg; niacin: 20.000 mg; D-Biotin: 45 mg; Apo Carotenoic acid ester: 500 mg; Folic Acid: 1 000 mg; Colin clorid: 125 000 mg; Vit C: 50 000 mg; Ks anthaxantine: 1 500 mg; Copper: 5.000 mg; Cobalt: 200 mg; Selenium: 150 mg; Manganese: 80 000 mg; Zinc: 60 000 mg; Iron: 60 000 mg; DL-Methionine: 99 % pure

Table 2: The percentage of live weight carcass, liver, testicle, heart yield and meat taste score of male birds

<table>
<thead>
<tr>
<th>Group</th>
<th>% Carcass yield</th>
<th>% Liver yield</th>
<th>% Testical yield</th>
<th>% Heart yield</th>
<th>Taste score of meat</th>
</tr>
</thead>
<tbody>
<tr>
<td>% 1</td>
<td>58.69±0.7</td>
<td>1.35±0.6</td>
<td>3.09±0.2</td>
<td>0.94±0.03</td>
<td>6.67±0.6</td>
</tr>
<tr>
<td>% 2</td>
<td>59.56±1.2</td>
<td>1.56±0.1</td>
<td>2.71±0.2</td>
<td>0.97±0.05</td>
<td>8.00±0.5</td>
</tr>
<tr>
<td>% 3</td>
<td>61.07±0.4</td>
<td>1.47±0.1</td>
<td>3.21±0.2</td>
<td>0.89±0.03</td>
<td>7.44±0.5</td>
</tr>
<tr>
<td>% 4</td>
<td>59.08±2.4</td>
<td>1.80±0.2</td>
<td>3.26±0.3</td>
<td>0.90±0.05</td>
<td>7.44±0.4</td>
</tr>
<tr>
<td>% 5</td>
<td>61.03±1.2</td>
<td>1.78±0.2</td>
<td>5.52±0.2</td>
<td>0.84±0.02</td>
<td>8.11±0.5</td>
</tr>
<tr>
<td>Control</td>
<td>61.47±0.5</td>
<td>1.54±0.1</td>
<td>2.98±0.2</td>
<td>0.96±0.06</td>
<td>6.88±0.4</td>
</tr>
<tr>
<td>P</td>
<td>0.502</td>
<td>0.151</td>
<td>0.152</td>
<td>0.30</td>
<td>0.209</td>
</tr>
</tbody>
</table>

et al., 2004a). Contrary to these findings, dramatic decrease in liver weights was determined in a study (Cetingul et al., 2007) where oregano was used instead of peppermint. In the same study, no significant effects of oregano supplementation in diet were found on the carcass, meat taste analysis and testicle weights. Likewise, in another study (Ankari et al., 2004), no difference regarding organoleptic tests were discovered among the groups.

Although no significant effect regarding testicle weight was observed in this study (P> 0.05), the numerical difference was remarkable (Table 2). The differences in testicle weights could be explained with insufficient sample numbers and an increase in standard error values. Since the average testicle weight in group 5 was numerically the highest among the groups, it was thought that peppermint could have an effect on the reproductive function of genital organs.

Confirming this thought, in a study on mice (Akdogan et al., 2004b), it was discovered that peppermint utilization in diets affected sperm activity.

A similar result was observed in meat flavor. Group 1 and the control group were scored with the same values while the other groups were scored with higher values (Table 2). The results showed the positive organoleptic effects of peppermint.

The MDA values, as one of the blood parameters, were found to be higher (Table 3) in the control group than the others (P< 0.05). Another parameter was AOA where significant differences were determined (Table 3). Group 1 and the control group were found to have lower values than the others in terms of AOA (P<0.05). The antioxidant activity values were higher in 3rd to 5th groups than the other groups (P< 0.05). Likewise (Kumar et al., 2007), it was reported...
that peppermint supplementation to diets increased the antioxidant activity in mice serum. In another study (Samarth et al., 2006), it was indicated that serum MDA values decreased in mice fed with peppermint extract supplemented diets which is in accordance with our findings. In other studies on rats (Akdogan et al., 2003) the animals were given peppermint tea for 30 days which resulted in the increase of lipid peroxidation and oxidative damage. Our results did not confirm these findings (Table 3).

The discrepancy with our findings was attributed to the provision of peppermint in tea form for 30 days. However, in our study different results were acquired although the 5% peppermint (in ground form) supplemented diet was carried out for 70 days. The difference between these studies could be attributed to the utilization of peppermint in different forms. Therefore it could be claimed that utilization of different forms (tea, extract) of a plant could result in different effects.

In this study, the difference between HDL and LDL values was determined (Table 3) to be significant (P< 0.05). The highest HDL value was observed in the group supplemented with 5% peppermint while the lowest value was found in the control group and group 1. Particularly, the amount of peppermint supplementation on a 3% level and over caused significant differences among the groups. Utilization of peppermint showed positive effects in terms of HDL cholesterol values. While the highest LDL values were determined in the control group, peppermint supplemented groups displayed rather low values (P< 0.05). Considering these low values, it could be claimed that peppermint decreased the amount of LDL cholesterol.

No significant differences (P> 0.05) were determined in terms of TG and TP (Table 3). A significant (P< 0.05) difference was observed in terms of cholesterol and glucose values (Table 3). Control groups displayed higher values for both parameters.

As a result, supplementation of ground peppermint into the diets of quails up to 5% level caused no adverse effects in our study. The peppermint supplemented groups were found to have better values in terms of testicle weight and meat flavor. Supplementing a diet up to a 5% level with peppermint was found to be rather beneficial in terms of blood parameters such as MDA, AOA, LDL, and HDL.

**CONCLUSION**

In conclusion, utilization of ground peppermint could be an important tool in preventing arteriosclerosis and other cardiopulmonary diseases since it increased the HDL and AOA levels and decreased the LDL and MDA levels. Moreover, this plant could be used in several treatments due to its antioxidant effect versus the detrimental effects of oxidation products in cells.


